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Effect of Gene Segregations on Existed Performance of Chicken Ecotypes in Ethiopia

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Abstract: Even if indigenous chickens are well adapted in harsh environment, they are poor in the reproductive and productive performances. Whereas, exotic chickens are showed reverse characteristics to the local chicken ecotypes. Therefore local chickens are required upgrading their performance through cross breeding. In Ethiopia purebreds were evaluated versus the performance of synthetic (F_1) chickens under village production system. Performance of local, crossed' and exotic chickens (Fayoumi, RIR, WLH and Yami) at Asella, Debrezeit, Hawassa, south and northern Ethiopia was evaluated. F1 chickens had significantly ($p < 0.05$) higher egg weight, egg mass, egg number than local and lower mortality rate, earlier age at sexual maturity, egg fertility, hatchability, age at first egg and adapted to tropics compared to exotics. QTL analysis fatness female and lean meat male parents were conducted from France. Gene segregation effects on productivity of non fat males were evaluated. QTL allele fatness in males was significantly inspected at F1 with the F value of 11.87 carrying recombinant GGA5. However, backcross breeding cM QTL wasn't significant in either sex (F2). Researchers, suggest that gene segregation is lost the overall characters and unexpected behavior might be observed. Therefore, in Ethiopia gene segregation effect, status of F1 backcrossed with the previous parent chicken ecotype and performance of new F2 progeny are completely absent and it is the future direction of the study.

Key words: Gene segregation · Ecotypes · Performance · Chickens · QTL Mapping

INTRODUCTION

Indigenous chickens are better in adaptation, resistant to low management, feed shortages and tolerate to diseases, even if their genetic potential is poor [1, 2]. Due to poor in genetic make-up they needed improving their genetic part through selection and cross breeding [3-6]. The productive performances of exotic chicken are better and produce higher number of eggs and more meat than local chickens [7]. In Ethiopia performance evaluation among crossed, local and exotic chickens were conducted from different research and development organizations and the overall performance of the crossed breed was better than either of the native or exotic parents under the existing production systems [1, 8]. The new crossbreeds are also well resistant to harsh tropics and produced a reasonable amount of egg and meat [9-11].

In addition to cross breeding performance evaluation, segregated gene effect in a breeding nucleus and location on the chromosomes with individual performance has been identified. Further back crossing with parents was the main cause of losses of available and heritable traits [11, 12]. Therefore, the purpose of this paper was to evaluate the role of segregated genes on performance of local chickens being undertaken in Ethiopia.

Methodology: The study was conducted on four randomly selected regions of Amhara, Oromiya, Southern Nation and Nationality of people and Somali region of Ethiopia. The research was designed, mainly focused on the retrospective study which was previously done on the existing performance of chicken ecotypes and gene segregations effects in the country. Information obtained from the retrospective data was briefly summarized and synthesized using SPSS-20.

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RESULT AND DISCUSSION

Performance of Indigenous Chickens: Diverse environmental conditions and different cultural orientations have contributed to the observed genetic variations of chickens. In Ethiopia many researchers reveled that performances of indigenous chickens are well adapted to the tropics, resistant to poor management, feed shortages, tolerate to diseases and provide better test of meat and eggs than exotic chicken. However, the findings revealed that indigenous chickens have poor performance in terms of egg size, slow growth rate, late maturity and slow age at first mating, small clutch size and hatchability. Various reports indifferent site showed that the quantitative traits performance of local chickens is varied because of genotype (additive, dominant and epitasis) and environmental effect. Indigenous chicken produced 30 to 60 eggs/hen/yr, at (WADU), 34 eggs /hen/yr at Asella, 18-57 eggs/year/ hen at Northwest Amhara, 36 eggs/3clch/yr/12-13egg/clch at Fogera, 10.05±0.15 egg/cultch 3.78 ± 0.07/yr, at Bure and eggs laid ranges from 53-60 egg/hen/yr at North-West Ethiopia. Therefore local chickens need relatively less environmental modification and highly genetic improvement to achieve increased productivity.

Performance of Exotic Chickens: Poultry production is a key to poverty reduction in the rural poor. As a result in Ethiopia, many attempts have been made to increase the performance of indigenous chickens. Among this first four breeds of exotic chickens (Rhode Island Red, Australop, New Hampshire and White Leghorns) were imported in 1950s.

Distributed exotic chickens performance evaluation (White leghorn, Road Island Red, Fayoumi and Yarkon) were conducted in some parts of Ethiopia such as at Assela, Debre Zeit, southwest Ethiopia, Hawassa Zuria and northern Ethiopia. Under village conduction, exotic chickens are late age at first egg such as Fayoumi takes 231±5.53 day, Road Is land red (239±5.73) and White Leghorn (245±6.08) and produced more egg with the corresponding values of 144±6.97, 173±9.35 and 185±8.82, respectively. The research result showed that, hatched percentage of White Leghorn (76.1±5.52), Fayoumi (67.9±4.11) and Road Island red (39.3±5.20%).

In Ethiopia the mortality of matured Fayoumi, White Leghorn, RIR and Yarkon was 35.3±4.50, 21.3±6.03%, 16.3±5.69 and 14% respectively. In general, according to the findings of this researche, all mean performance of exotic chickens had better but tropical conditions are the great challenges in extensive farming systems which helped to develop cross breeding scheme.

Table 1: Production performance of indigenous chicken

Traits	Performance	Study Site
Aafe	217 day	HUCA
Aafsm	169 days	S. Ethiopia
Egg/year	45	WADU
	34	Asella
	37.5	N. Ethiopia
	36egg/3clch	Fogera
	56.5	N-W.Ethiopia
Hatchability%	82.83	Bure
Fertility%	78.6	Bure

AAFE = age at first egg, Aafsm= age at first sexual maturity HUCA =Hawassa university college of agriculture, WADU=wolita agriculture dev· t unit

Performance of F_1 crossed Chickens: Exotic chickens produce higher number of eggs and more meat than the indigenous but tropical climate is great challenge. Due to, this variations in Ethiopia crossbreeding experiment was conducted to produce good performance and adaptive synthetic chickens. The result showed that, many research centers and development organizations found that, the performance of local, exotic and crossed birds were evaluated. Therefore, at Debre Zeit Agricultural Research Centre local chickens were compared with White Leghorn and overall performance of F1chickens were better than either the native or exotic parents. The 50% and 62.5% Leghorn crosses produced 146 and 193 eggs, respectively.

Yarkon crossed with local chickens' at Assela, F_1 50% chickens were produced 129 eggs which were found to be better than their parents. The hybrid chickens showed variation on hatching weights, gain, egg production quality and mortality from their parent.

Performance evaluation was conducted on crossbreeding between Road Island red and Fayoumi with any local and necked neck chickens. Synthetic chickens were showed better performance than their parents and suitable for tropics. Similar experience was also seen by resulting from crossing effect age at first egg was reduced by a few days in the FN crosses and by more than a month in RIR and L crosses compared to their respective female parents. In addition age at first egg was reduced by a few days in crosses of Fayoumi and RIR with Naked neck and any local chickens the numer of egg in Fayoumi X Naked neck was increased by almost half compared to the pure necked parent. In general performance evaluation of local, exotics and their F1 crosses from existing condition are presented below in Table 3.

Table 2: Productive and reproductive performance of exotic Chickens

Parameter	WL	Y	Fayoumi	RIR
AAFE(day)	245±6.08	Na	231±5.53	239±5.73
Aafsm(day)	163	Na	Na	168
EN/year	173±9.35	160	144±6.97	185±8.82
EW(g)	58	61	42.5±0.5	59.290±5.15
EM(g)	9600	9800	1946.9±76.5	1375.5±80.6
AEST(mm)	Na	Na	0.33±0.01	0.29±0.01
YH	Na	Na	16.6±0.1	18.2±0.1
AH	Na	Na	5.4±0.2	9.6±0.2
EL(cm)	Na	Na	5.4±0.2	7.63±0.38
EWd	Na	Na	38.6±0.2	46. 27±4.09
YC	7.9	Na	4.9±0.1	4.7±0.1
HatchWt(g)	25.48	Na	Na	30.12±2.86
Mortality Chick%	48.8±8.75	53	67.9±6.52	33.3±8.25
Mortality Pullets%	48.5±6.45	14	22.4±4.81	27.3±6.08
Mortality Layers%	21.3±6.03	14	35.3±4.50	16.3±5.69

WL= white leghorn, Y = Yarkon, RIR= Road Island Red and Na=not available

Table 3: Performance of local, exotics and crossed with F_1chickens and management practice

	Local breeds			Exotic breeds				F_1 Crossed breeds		
Traits	Any local	NN	WL	Y	F	RIR	YxL	FxN	RIR xL	WLxN
AAFE	217	204	245	187	231	239	205	196	198.3	224.3
E /y	64	82	185.9	160	145	173.4	129	119	90.8	120
EW(g)	44.1	49	58	61	42.5	59.3	48	29.1	51.91	49. 05
EM(kg	3	4	9.6	9.8	1.95	1.38	6.1	1.25	1.26	6.91
CM%	57.4	40	48.8	53	67.9	33.3	54.2	19	28.3	45.23
MP%	25	26.5	48.5	14	22.4	27.3	21.8	17	23.89	39.4
ML%	15	11	21.3	14	35.3	16.3	14.3	9	40	11
Frtility%	78.6	81	76.1	72.3	67.9	39.3	81.1	81.9	78.74	79.33
Hat/%	82.8	89.7	76.1	69.5	67.9	39.3	77.1	91.8	95	93.2

AAFE = age at first egg, EW = egg weight, EM = egg mass, CM = chick mortality, MP = pullet mortality, LM, = layer mortality, L= local, F= Fayoumi, and Y = Yarkon, E /y = egg per year

Effect of Segregated Gene on Performance: Under long-term artificial selection major genes are segregated in a population and heritable narrow sense additive gene action can result from non additive gene action effects on traits. Long-term selection in the same strains increase homogeneity and the frequencies of unfavorable alleles were relatively high. Performance of chickens are governed by major genes, which suggests that the existence of resistive genes affecting both production and reproduction traits under long-term backcross genes segregation. For marker-assisted selection, the important question is what part of genetic variation is explained by observable alleles as strong selection for quantitative traits may lead to the appearance of new genes with large effects. Segregation is possible for genes with large effects in the poultry breeding nucleus. Furthermore, feed consumption observed that the birds carrying naked neck (Na) crossed frizzle (F) F1chickens significantly consumed more feed compared to frizzle (F) parents and over crossing effect again lost this behaviors due to gene segregations.

Back cross Effect of Gene Segregation (F2) and QTL Mapping: At molecular level gene segregation effect was evaluated in a single QTL cross breeding analysis in excessive adipose tissue, fatness females breed and lean meat male breed parents. No significant QTL was detected in combined sex from the parent population. However, combined test comparisons a single QTL interacting with sex versus QTL wasn't detected at 112 cM. Quantitative trait loci analyses performed within each sex separately F ratio showed significant ($p < 0.05$ chromosome-wide) in males at 80 cM of and QTL ($p < 0.07$) chromosome-wide) in females at 116 cM at a parents level. The estimated

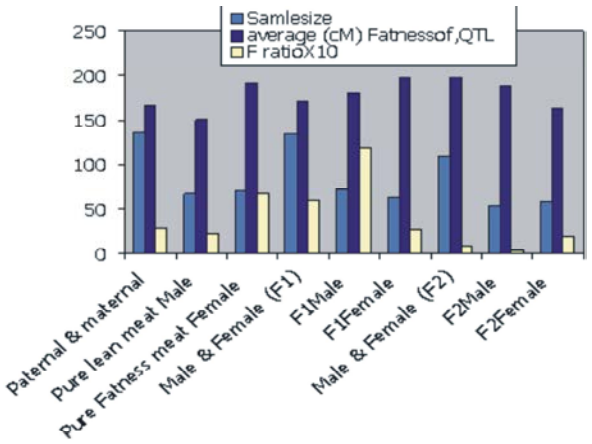

Fig. 1: Location and effects of fatness QTL on GGA5 in parents

additive effects of QTL were of the same magnitude in both sexes (0.4 and 0.5) in males and females, respectively. In this case, high QTL allele came from the fat haplotype in females and from the lean heliotype in males from (F1).

In the parents' significant fatness QTL was identified in females but not in males, whereas in crossed breed fatness QTL was segregating in males. In both cases, the most likely location of the QTL was at the specific part of GGA5. No significant QTL was identified in F2 hybrid in either sex. The magnitude of the QTL (fatness) effects was similar in males and females at heritability table value of family two (F1). Moreover, from Germany who evaluated the phonetic performance of parent White leghorn and Newhampshaire and their F1 and F2 chickens and they showed that gene segregation was negatively affect the performance of chickens at F2 and mostly observed after F2 generation (Figure1).

Moreover, under, F1and F2 family level back-cross effect on production and reproduction performance trend experience was evaluated. The pure parent White leghorn and Newhampshaire age at first egg was 155 ± 4 and 146 ± 2 with143 ± 1day of their first crosses. Gene segregation effect on performance of chickens were evaluated which illustrated higher (pure), modern (F1) and lower (F2) performance trained were observed such as live weight of chickens which had 2.8 ± 57, 1.48 ± 92, 2.36 ± 41, 1.69 ± 15 and 1.76 ± 15kg for New Hampshire (NHI), White Leghorn (WL), NHS x WL (F1), F1 x WL (F2) and F1 x NHI (F2), respectively.

DISCUSSIONS

Indigenous chickens are better in adaptation in the tropics [1, 2]. However, exotic chickens produce higher number of eggs and more meat but tropical climate is a great challenge [8]. Indigenous chicken possesses a great potential for genetic improvement through selection and cross breeding [6, 7]. Under Ethiopian village conduction, different studies showed that exotic chickens were late age at first egg than local (217) such as Fayoumi takes 231±5.53 day which was earlier than Road is land red (239±5.73) and White Leghorn (245±6.08) but produced more egg with the corresponding value, of 144±6.97, 173±9.35 and 185±8.82, respectively [13]. In the same research result local chickens had highest hatched percentage followed by White Leghorn, Fayoumi and lastly Road Island red within the values of 78.6±4.86, 76.1±5.52, 67.9±4.11and 39.3±5.20%, respectively [14]. Similar result was reported from Nigeria; local feathered and naked neck chicken had the highest fertility percentage than White Leghorn with the values of 87.65, 83.61 and 80.62% correspondingly. However, egg hatchability in White Leghorn had the highest value followed by the normal feathered and naked neck with the values of 92.05, 84.62 and 82.63% respectively [15]. Additionally from Tanzania the fertility of chickens were 92.0 ± 4.14, 91.1 ± 4.42 and 94.5 ± 2.21% with the hatchability of 52.2 ±2.54, 64.0 ± 2.16 and 80.6 ± 1.43% for local, RIR and crossbred chickens respectively [16].

Table 4: Performance traits and body weight on white leghorn, Newhampshaire and, F1 and F2 crosses

	Pure Parents	F1		F2	
Production traits	New Hampshire(NHS)	WLH	NHSxWL	F1 x WL	F1x NHI
Age at first egg (days)	146	155	143	142	138
Egg number/ year	94	64	93	92	88
Egg weight (g)	52	46	56	43	48
Body weight (kg) x10	28	14.8	23.6	13	15

AFE, age at first egg; EN=number of eggs, EW=, egg weight from, BW=body weight of hens, WLH= White leghorn, Newhampshaire

In general, according to the report of the above researchers all mean performance of exotic chickens had better than the locals but tropical conditions are the great challenged in extensive farming systems which helped to develop cross breeding scheme [17]. At molecular level gene segregation effect was evaluated by Goraga *et al.* [18], in France who reported that a single QTL cross breeding analysis with in excessive adipose tissue, fatness meat females breed and lean meat male breed parents [19]. In crossed breed fatness QTL was segregating in males but F2 hybrid significantly lost fatness characteristics, in either sex due to gene segregation effect [20]. Additionally from Tanzania the fertility of chickens were 92.0 ± 4.14 % with the hatchability of 52.2±2.54, % for RIR chickens.

CONCLUSIONS

Indigenous chickens have good adaptive performances to hot and humid tropics but poor in reproductive and productive performance. However, exotic breeds have reverse characteristics to indigenous chickens. To create stable performances of indigenous chickens' different work were done from Awassa, Assela and Debrezeit, southern and northern Ethiopia. Newly produced F1feasible zygote was showed better performance. Moreover, quantitative performance of chicken ecotypes is affected by gene segregations. At molecular level effect of gene segregation status is not evaluated in Ethiopia, even the performance of F1 chicken is not well documented and effect of gene segregation is totally absent. Therefore thus, an in-depth at molecular level status of quantitative trait loci at specific location with MAS should be undertaken to confirm the level of performance affect by gene segregation from indigenous chicken ecotypes.

REFERENCES

1. Alemu, Y., 1995. Poultry production in Ethiopia. World's poultry. Sci. J., 51: 197-202.
2. Gueye, E.H.F., 1998. Village egg and fowl meat production in Africa. World's poultry. J., 54: 73-86.
3. Peters, S.O., 2008. Genetic variation in the reproductive performance of indigenous chicken and the growth rates of its pure and half bred progeny. M.Sc. Thesis. Dept of Anim. Breeding and Genetics University of Agriculture. Abeokut, pp: 120.
4. Adedeji, T.A., A.O. Ojedapo, S.A. Ige, A.O. Akinwunmi and S.R. Amao, 2008. Genetic evaluation of growth performance of pure and crossbred chicken progenies in a derived savannah environment. Proc. of the 13thAnnual Conference of the Animal Science Association of Nigeria, (ASAN), Sept. 15-19. ABU Zaria, pp: 8-12.
5. Nimbkar, C., J. Gibson, M. Okay, P. Boettene and J. Solemner, 2008. Sustainable use and genetic Improvement. Animal Genetic Resources Information, 42: 49-69.
6. Adebambo, O.A., C.O.N. Ikeobi, M.O. Ozoje and O.A. Adebambo, 2009. Variation in growth performance of pure and crossbred meat type chickens. Nig. Journal of Animal Production, 36(2): 211-227.
7. Ali, K.O., A.M. Katule and O. Syrstad, 2000. Genotype X Environment interaction for growing chickens: Comparison of four genetic groups on two rearing systems under tropical condition. Acts Agriculture Scandinavia, Section A-Animal Sciences, 50: 65-71.
8. Islam, M.A. and M. Nishibori, 2009. Indigenous nakedneck chickens: A valuable genetic resource for Bangladesh. World's Poult. Sci. J., 65: 125-138.
9. Iraqi, M.M., E.A. Afifi, A.M. Abdel-Ghany and M. Africa, 2005. Diallel crossing analysis for live ability data involving two standards and two native Egyptian chicken breeds Livestock Research for Rural Development, 17(7).
10. Tadelle Dessie, 1999. Studies on village poultry production systems in the, central, highlands of Ethiopia. MSc. Thesis submitted to Swedish University of Agricultural sciences, pp: 70.
11. Mekki, D.M., I.A. You if, M.K. Abdel Rahman, J. Wang and Musa, 2005. Growth performance of indigenous X exotic crosses of chicken and evaluation of general and specific combining ability under Sudan condition. Int. J. Poult. Sci., 4: 468-471.
12. Behnam, A., P. Frédérique, L. Sandrine, L.B.D. Elisabeth, L.R. Pascale, D. Olivier, V. Florence, S. Jean, C. Larry, A. Sammy, V. Alain and D. Madeleine, 2005. Fatness QTL on chicken chromosome 5 and interaction with sex. Department of Animal and Food Sciences, University of Delaware Newark, available attp: // www.edpsciences.org / gseorhttp: // dx.doi.org / 10.1051 / gse: 2006005, pp: 297-311.

13. Goraga, Z.S., M.K. Nassar and G.A. Brockmann, 2011. Quantitative trait loci segregating in crosses between New Hampshire and White Leghorn chicken lines: I. egg production traits. Department for Crop and Animal Sciences, Humboldt University, Berlin, Germany, 43: 183-189.
14. Besbes, B., 2009. Genotype evaluation and breeding of poultry for performance under suboptimal village conditions. World's Poultry Science Journal, 65: 260-271.
15. Tadelle, D., 2003. Phenotypic and genetic characterization of local chicken ecotypes in Ethiopia. PhD Thesis, Humboldt University of Berlin, Germany, pp: 209.
16. Fassill Bekele, T., H.M. Adnoy, J. Gjøen, Kathle and Girma Abebe, 2010. Production Performance of Dual Purpose Crosses of Two Indigenous with Two Exotic Chicken Breeds in Sub-tropical Environment, Department of Animal and Range Sciences, College of Agriculture, Hawassa University, Ethiopia, pp: 702-708.
17. Meseret Molla, 2010. Characterization of Village Chicken Production and Marketing System in; M.Sc thesis Submitted to the Department of Animal Science, Jimma, University, College of Agriculture and veterinary Medicine, School of Graduate Studies, pp: 54.
18. Kidane, H., 1980. Performance of F1cross breeds. Welaita Agricultural Development Unit. Animal husbandry and breeding. Welaita Sodo, Ethiopia. Bulletin, 4: 33.
19. Brannang, E. and S. Person, 1990. Ethiopian animal husbandry and Breeding in the Tropics and Sub-tropics. Humboldt University of Berlin, Germany. Uppsala, Sweden, pp: 127.
20. Halima Hasten, 2007. Phonotypic and genetic characterization of indigenous chicken populations in Northwest Ethiopia. PhD. Thesis submitted to the faculty of National and agricultural sciences department of animal Wild life and Grass land Sciences University of the Free State, Bloemfontein and South Africa.